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Unravelling the gas physical conditions in the starburst galaxy NGC 253

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Various feedback mechanisms, such as star formation, large-scale outflows, shocks or Active Galactic Nuclei, affect the shape and evolution of galaxies. Starburst galaxies, in particular, show exceptionally higher star-formation rates compared to regular galaxies (e.g. the Milky Way), indicating different physical conditions. Understanding how these physical conditions differ in starburst galaxies is crucial to study their evolution.

Star-formation gathers several physical processes, each associated with a specific gas component (e.g. dense, turbulent, shocked gas). Thanks to powerful millimetre interferometers (e.g. ALMA, NOEMA), it is now possible to disentangle gas components down to scales of Giant Molecular Clouds (i.e. tens of pc) using molecular line emission. NGC 253 is the nearest (d~ 3.5 Mpc) brightest starburst galaxy in both the infrared and millimetre ranges and is thus the best target to study physical conditions in starburst galaxies.

The ALMA Comprehensive High-resolution Extra-galactic Molecular Inventory (ALCHEMI) provides the first unbiased molecular survey (84.2 - 373.2 GHz) towards the Central Molecular Zone (CMZ) of NGC 253, at an unprecedented angular resolution of 1.6" (~27pc) (Martin et al. 2021). In this context, we investigated the CMZ of NGC 253 using sulphur-bearing molecules, known as effective in reconstructing the dynamics of the studied object. We found that these species belong to different categories of gas (e.g. cold vs hot and quiescent vs shocked), and we could extract the various physical conditions associated with the CMZ of NGC 253 and compare them to those found in the Milky Way and other external galaxies.

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